

## **“GREEN BUILDINGS AND HIGH-PERFORMANCE FOR SUSTAINABILITY IN THE URBAN ZONES OF CONTEMPORARY ARAB CITY”**

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### **ABSTRACT:**

We know that the urban development is a contemporary problem in the Arab cities in the 21th century by using advanced architecture and advanced technology in the urban buildings.

The important here is the negative effect and the unbalanced urban development in the city. But if we take care with some important elements like equity in distributing and suitable for Housing and Services in the urban zones we could realize our liabilities for the urban progress.

We means about the Green buildings it's general purport in the Housing zones and how it realized the high-performance with contemporary constituent and urban sustainability.

The research study the green buildings in the urban Arab cities and the aims we need from it. How we could set the control of the climate exchange and in the same time the high-performance of sustainability. The final study how we realize the sustainable urban development with the green buildings in the Arab cities.

### **THE PROBLEM:**

The research study the new and modern architecture which considered in the case of widespread in Arab cities.. But with many types of modern and beautiful designs not realized the treatments of the hot climate, and not benefit with the Sun Energy, the wind and freeness from pollution. And we try to benefit from the idea of the Green buildings in making good designing for giving solutions for the hot climate.. and realizing the thermal comfort. And in the same time realizing the beautiful campus in buildings, planning and green areas. Then we could study the elements of sustainability and green building in the Arab cities.

## **FIRST TOPIC: THE GREEN BUILDING AND THE ENVIRONMENTAL DESIGN:**

The green building is a system with a high quality which be in accordance with it's vital surrounding without any pollution.

The green building means beautiful design housing comfort.. that means there is green plants in and out houses and in good relationship with the green environment in the housing campus. That means that the green buildings is a friendship with the surrounding environment. (Fig 1)

This give us a meaning of up grading system in urban settlements in the Arab countries which lied in the hot zone.

In the other hand people must understand that meaning of development which realize the elements of economics and the optical designs in buildings and urban zones.

### **1-1 \* CULTURE AND CONCEPT OF THE GREEN BUILDING:**

These are many important points considered the main idea of the culture and concept of the green buildings:

- Architecture designs: must be suitable to the hot climate.
- Housing comfort realized in the design and taking in consideration the social traditions.
- Sun Rays: in the hot climate is the effective one in-door the houses.. then the building design give the solution to protect buildings form that hot rays.
- Beautiful facades: by using plants and flowers in the balconies and realizing shades in the facades.
- Human scale: to give peoples good feeling by using the suitable height for housing building to be low height housing and specialty.
- Urban safety: to realize the separation between the motor moving and the houses spaces and green areas specially for peoples and children's jocs
- Trees and plants: it is very important for the hot climate to give shadow in land and the housing buildings and at the same time gives beauty.



Figure 1. Model of the green housing building

### 1-2\* ENVIRONMENTAL DESIGN:

Environmental design expressed about putting system for design the housing space (or campus garden) and surrounding buildings aims to realizing the elements of comfort, safety, speciality, the beauty and the items of settlements.

The Environmental design is realized by taking care with these elements:

Human scale for spaces:

- That item realized by: the lower and middle hight of the houses to see the sky line easy, to see the trees, plants and green areas clearly in a comfort space.
- Spaces and peoples activities: The suitable spaces in area and components considered one of the important elements of encouraging peoples to settle and to have comfort which is realized by many services for them and their children as:
- Housing spaces: in between buildings realizing containment, relationship to campus, distinction designs..

Green areas in this space have many activities like:

- places for setting: for men and women with umbrellas, seats, flowers and trees.
- Toys for children: these land is near and under supervision of their families, far from auto-roads and parkings.
- Halls for playing and gymnastics and social activities: In the ground floors of the Green buildings with a colonades protected from sun-rays.
- \*Out space of housing campus playgrounds: It sets out the campus in areas for boys protected with trees.
- \*parking: for the dwellers in many locations out of the inner housing space and in connected with local roads and protected from sun rays with trees. see fig (2), (3)



Figure 2. Housing campus in Jeddah city in Saudi Arabia Kingdom



Figure 3. Al Rehab Housing Project in Cairo city in Egypt

## **SECOND TOPIC: CLIMATE IN THE ARAB ZONE:**

The Arab countries are setting in the north of the geographic equator. The sun is shine in the most months of the year specially in summer, where the hight degree is 39.2 in April and 44.8 in August in Riyadh city (kingdom Saudi Arabia) as an example and 37°.4 in April and 43°.2 in July in Syeun city in Hadhramout valley in Yemen <sup>[2]</sup>. Fig (4) <sup>[1]</sup>

We see that the degree of temperature is high in summer above 40°.that means that the peoples could not to endurance it indoor and in outdoor their houses. Thus our grandfathers at the last centuries tried to treat that difficult case by using:

- Using the local building materials (mud and stone) in establishing the houses by retaining walls.
- Using the inner court for specialty and to have more shadows from plants and trees planted in this court, in the other hand the beautiful view.

- Wind catcher: they built this distinction type of building to catch the cold air or the hot air and to cold it indoor the house.
- Oriels: which give the specialty for the dwellers and protect the house-rooms from the hot sun rays. But now we see the most dwellers used air-conditioning apparatus in their houses which consumes big amount of Electrical Energy in these days which cost us more than we could not endurance...

Now the Arab city became very wide in it's urban area with high blocks of housing and more consuming of electrical energy.. then it is a big problems in our present age.

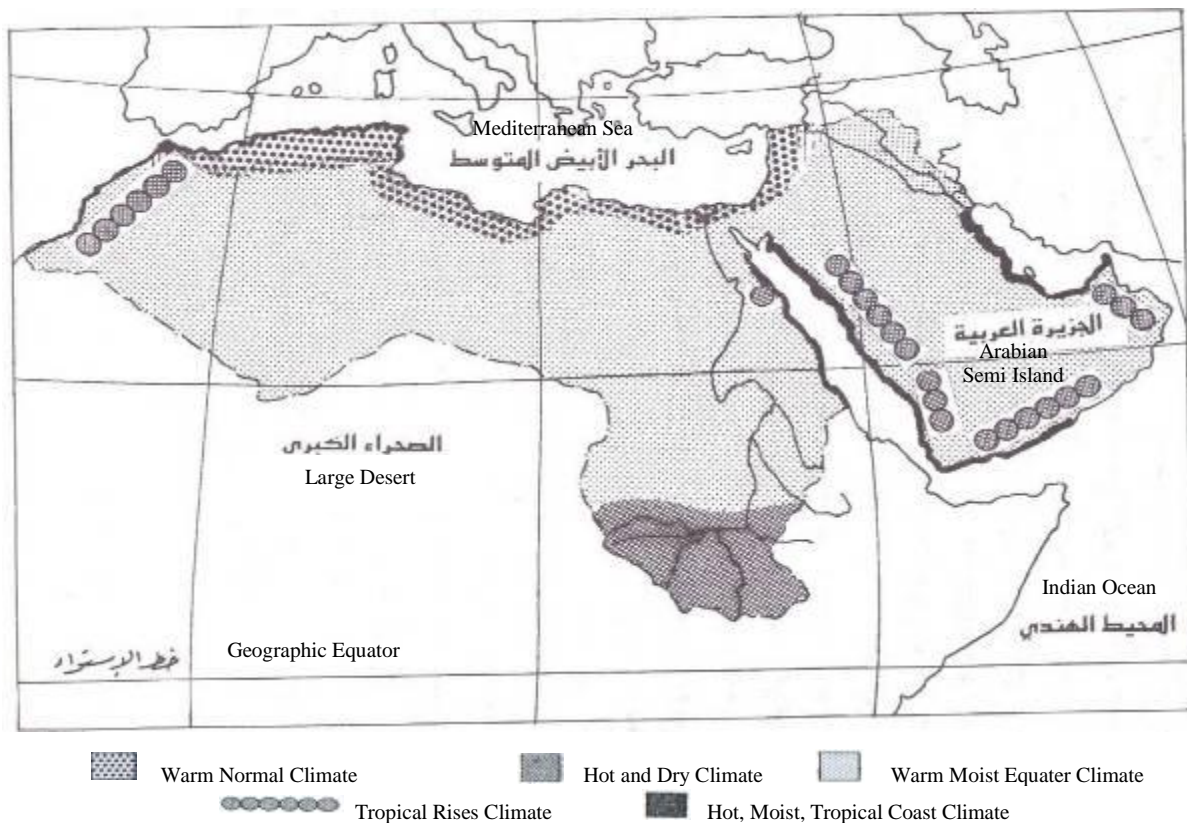


Figure 4. The Arab Countries Map<sup>[1]</sup>

### **THIRD TOPIC: GREEN ARCHITECTURE AND HOT CLIMATE:**

Hot climate effectiveness negative on the life of peoples, and they could not their life activities in the positive case because of the hot exhaion.

For that reason and to realizing the comfort climate and the green building – the environmental friendship –it must study two elements:

\*The architectural design suitable to the case of hot climate (hot environment).

\*The effective environment is related to the case of hot climate.

#### **3-1\*THE ARCHITECTURAL DESIGN SUITABLE WITH THE CASE OF HOT CLIMATE:**

The good architectural design for green building which is realized the aims which treat the case of the hot climate and given the comfort climate to peoples indoors their houses and to have the fine social and psychology case and the economical consumption in using electrical energy.

Here could give in short the main elements and considerations in architectural designs for the building of houses as the following:

- Functional relationships: it must be in good case as to arrange the house elements in consideration with the social traditions and specialty.

- Distinction designs for the facades and in it's components and to be beautiful by using the suitable structure and building materials of the present age.
- Natural lighting and ventilation: by the good design for windows and doors and the correct direction of the building to realizing good lighting and cross-ventilation indoor houses and flats.
- Shade and shadow: in facades specially the facade of the south direction. And to increase shade by using: Balcones, shades and green plants in floors of the buildings.
- Heat isolations: to use materials for isolation in ceilings and some outer walls for protecting from the hot sun rays, another pollution is to have double ceiling for the roof with opening for ventilation – or using water, or plants upon the roof which isolated heat.
- Technology and building materials: is very important to use the insulated building materials for heat, for sound in buildings specially for houses and to be benefit with the characteristics of building materials which give time lag for heat to reach to the inner spaces of the house as in table (1) <sup>[3]</sup>

**Table (1) characteristics of building materials**

Material	Thermal conductivity	Heat capacity	Time lag
Bricks	24.00	0.42	10.40
Facade Bricks	26.00	0.75	6.10
concrete	29.40	1.00	7.50
Gypsum	20.30	0.25	12.40
Iron	54.00	27.60	1.90
Limestone	22.70	0.54	8.90
Marble	34.00	1.50	6.60
Plastic paint	22.40	0.43	10.00
Wood lumber	10.90	0.067	16.80
polystyrene	0.30	0.023	4.90
Rubber	68.60	0.08	40.00
Sand	18.00	0.19	13.40



See Fig (5) & (6) & (7) and (8)

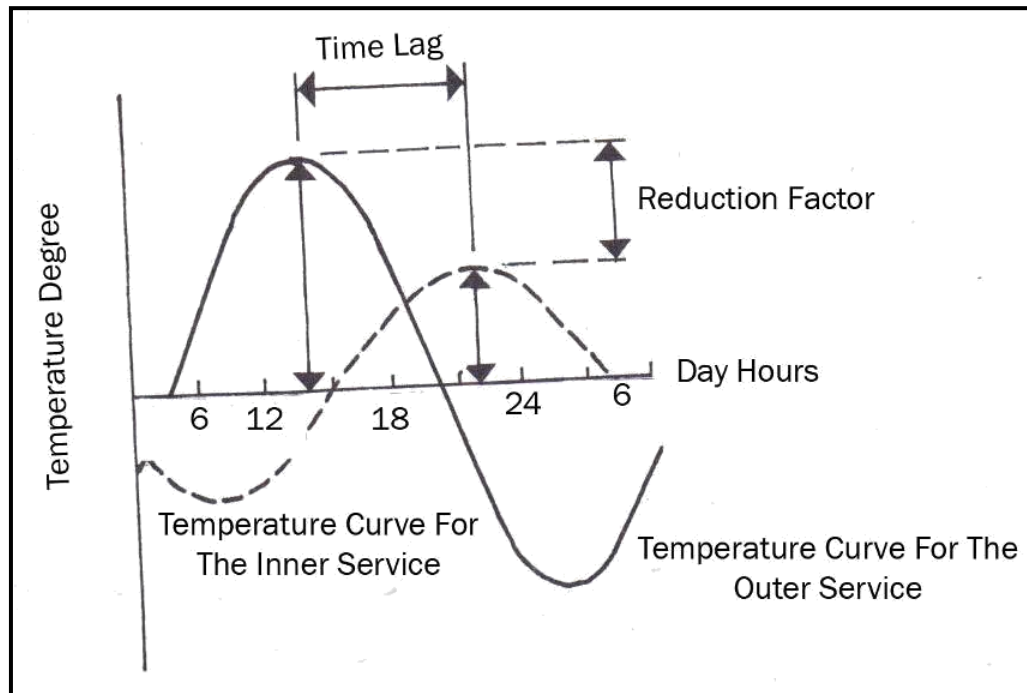


Figure 5. The effect of the heat capacity upon the heat flow (Time lag)

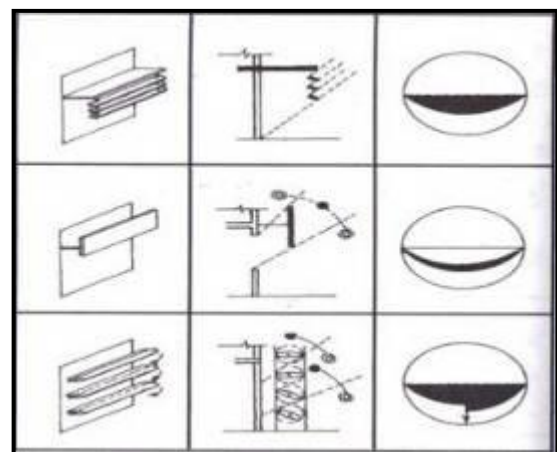
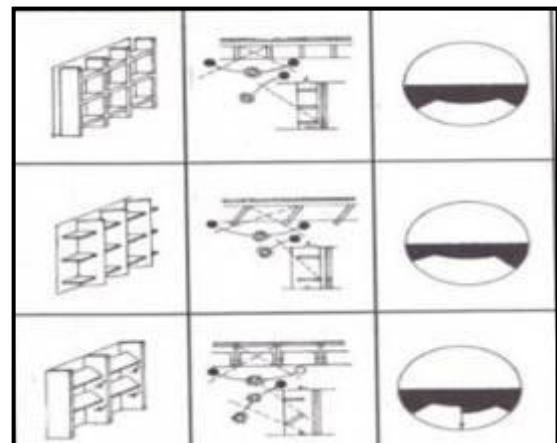


Figure 6. Some types of sun breaks in buildings and feeding with shade and shadow on it in the hot climate

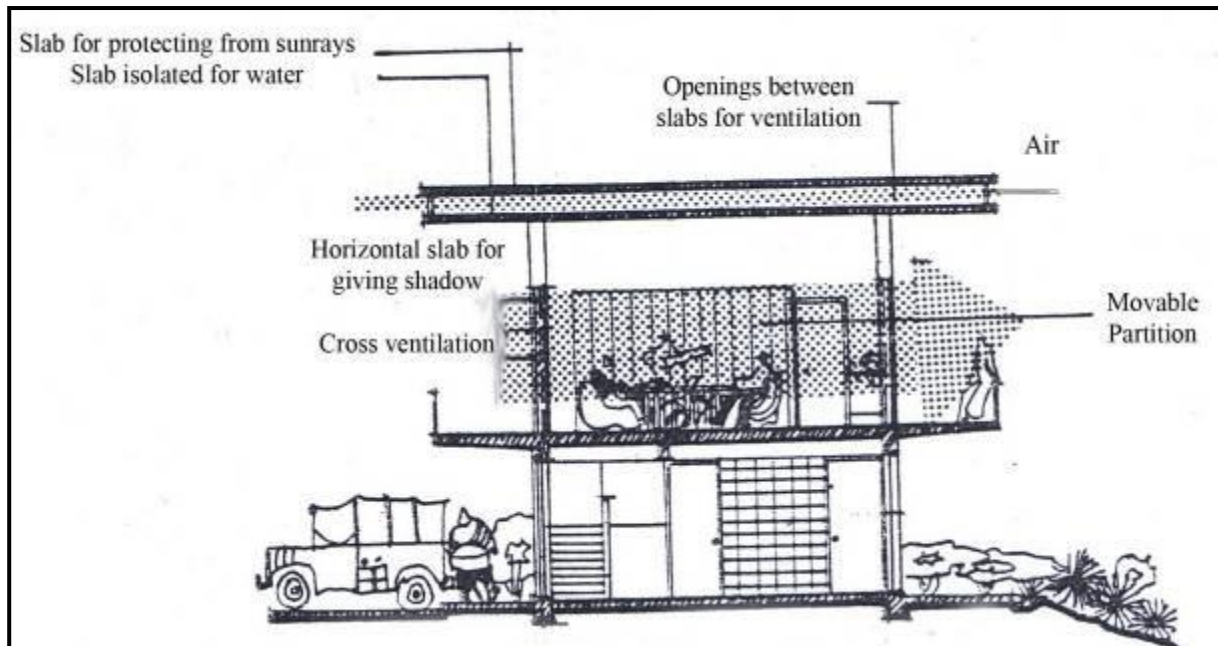


Figure 7. Ventilation in between the last ceilings (double ceilings)

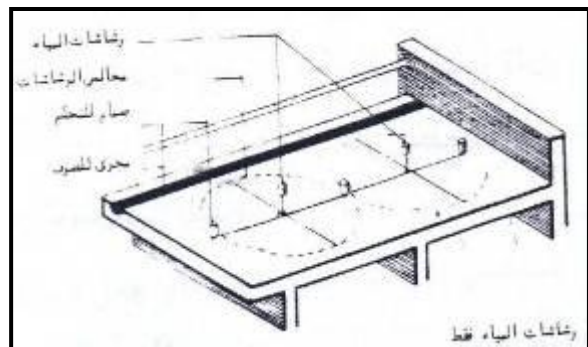


Figure 8. Two cases to reduce the hot temperature up ceilings by using water and other by planting green areas above it.

### **3-2\* THE EFFECTIVE ENVIRONMENT IS RELATED TO THE CASE OF THE hot CLIMATE:**

The surrounding environment of buildings is contain of green areas, trees, plants and flowers and artificial lakes of water. That environment is very necessary for housing in the hot climate.

There are many considerations for the good and useful environment to help in realizing the comfort heat in the houses (special houses of flats in buildings) as following items:

- Green and big trees: for giving shadow on dwelling buildings and on pedestrian roads in the site of the housing area.
- Green areas, plants and flowers: for giving beauty on the site, and making control to the sun hot rays not to reflected to the house buildings (or to be little)
- Pedestrian roads and the suitable building materials: pedestrian roads is very necessary to people or dwellers to go to their houses, buildings from parking and to move to services, settings, to sites of children. We need to put some points of control like:
  - to put the correct planning for the pedestrian roads and with the suitable – widths.fig (9)
  - to use building materials, hard and beauty surfaces, and not reflect sun rays.
  - shadow trees: to plant it along pedestrian roads, and around parking areas to give shadow for it and for people when they moving in the day.



Figure 9. Gardens Flooring Roads

**FORTH TOPIC \* GREEN BUILDINGS AND SUSTAINABILITY: sustainability means to be alive, to be use and to be change to be suitable using in the next centuries.**

We study the green building which be accordance with the surrounding environment and completed it, and at the same time not to make any pollution.

That characteristics for the green buildings means the sustainability in the Arab urban cities by taking care with these points.

**4-1 \*THE FINE ARCHITECTURE DESIGN OF THE GREEN BUILDING:**

It must realized many rules:

- The good relationships between the functions and the houses elements.
- The characteristics of the inner building walls to insulated to voice, heat and from light sheets or bricks which could change it's locations to give flexibility in design.
- Building technic and consideration: it mean the fine quality of building materials and structures, and at the same time realizing the factors of safety from fire, hard wind pressure (storms), earthquakes, and others.

- Flexibility in changing the interior design of the house by using light walls or metal and sandwich panels, that is to have changing suitable to social case and time.
- Elements of shadows in facades: like sun breakers shades and balconies to give shadow in large areas.
- Heat isolations for new building materials: and the insulated materials in aim to have the comfort heat indoors houses (green building)
- The correct choice for lands and buildings: by doing studies about land for housing, the suitable type of foundations in related to the hight of building.
- Fine and clean environment: the site may be empty of any pollution from air, sweepings and sanitation. and that is one of the most important elements of the green building.



#### **4-2 \* ENVIRONMENTAL PLANNING SURROUNDING HOUSING BUILDING:**

The suitable urban planning for housing zones is considered a type of complementation between the building environment and the natural environment. And by the urban planning which put in consideration the basic regulations of human activities and the high performance of the environment.. to realize the comfort degree of heat in the months of summer specially in the Arab cities.

The basic regulation of sustainability in the environmental planning:

##### **4-2-1\* HOUSING GROUPS:**

That mean the systems of locating the housing blocks, and putting it in the correct direction to North in the aim to have cross natural ventilation and avoid the hot sun rays, and have shadows.

##### **4-2-2 \* HOUSING GROUPS INNER SPACES AND GREEN AREAS IN FUNCTION:**

That is very important for the dwellers in the aim to realizing the function for that space like:

- Special space for every group of housing.
- It has trees and green areas especially for them.
- It has places for setting and toys for children and services in the ground floors. fig (2)
- Parking areas for the dweller's cars and out of the main spaces of the housing groups for realizing safety for children.

##### **4-2-3\* PEDESTRIANS PLANNING:**

it aims to:

- Limitation the correct direction for peoples or inhabitants to move to his house or building to services to the setting places in the green area and to the parking.
- Limitation the width of the pedestrian ways. Which realized the sufficient in using it.
- Using suitable materials for pedestrian ways to be from high fineness (quality) and not reflecting the hot sun-rays.

##### **4-2-4 \* TYPES OF TREES,PLANTS SUITABLE TO HOT ENVIRONMENT:**

These types gives shadows on land and above the buildings in the summer and these types like:

- Shadow trees: like viecas trees.
- Shadow and flower trees: like bonsiana trees and kassia trees.
- These types of trees is very fine and beautiful and fast growing, and very benefit to give oxygen and absorb carbon oxide two and air pollution.

#### **4-3\* BUILDING MATERIALS AND ENVIRONMENTAL SPACES:**

Building materials developed upon the different ages toward new and fine materials to be suitable to the developing in industry and technology which gives many alternatives suitable to used in urban environment.. and that gives the solutions to upgrading our urban cities in the Arab zone.

We give an idea about some new models of materials used by it's characteristics in treating the case of the hot climate.

##### **4-3-1 \* THE MAIN BUILDING MATERIALS:**

For building foundations, ceiling and walls like:

- Bricks { from mud and from cement }.
- limestone.
- wood.
- Concrete.
- Steel sections.

For using it in good environmental case and realizing building stability it must realized some specification like:

- High consolidation.
  - Heat capacity insulation materials:
    - Artificial like polystyrene and polyurethane as a sheets for isolation ceilings and walls.
    - Metals like glass wool and mineral wool.
    - grains materials: it contains of:
      - grains: like polystyrene.
      - fibrils: like roals and slices as mineral wool.
- Artificial hard sheets foam, foamy concrete.  
materials in site like polyurethane.

See fig (5), (10) and fig (11):



Figure 10. Some of the insulation materials<sup>[1]</sup>

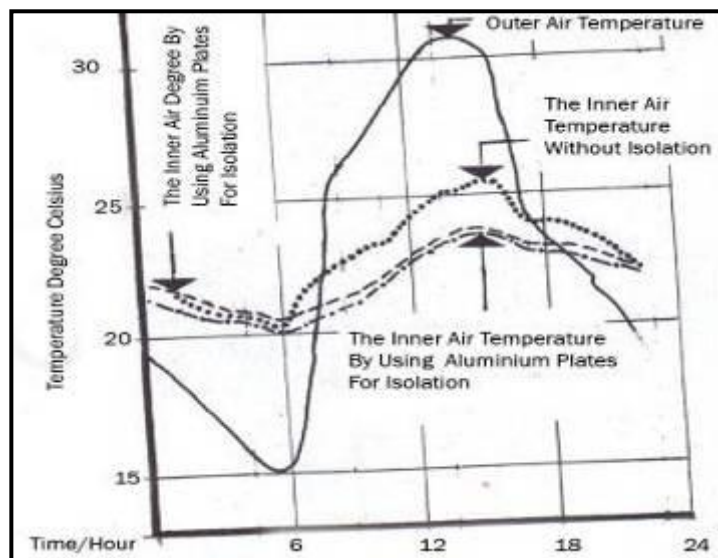


Figure 11. The effect of the heat insulation up the heat degree of air<sup>[1]</sup>

- The effect of material and colors upon the heat isolation of the sun rays: the most perfect use for the material of building to isolation of sun-rays and the color which is preferred in the Arab zone building (the white paint) fig (12)<sup>[1]</sup>
- The perfect insulation materials:  
The glass is one of the important material used in buildings specially in facades, then the choice of the suitable type which has the environmental specifications is the best one fig (13)<sup>[1]</sup>

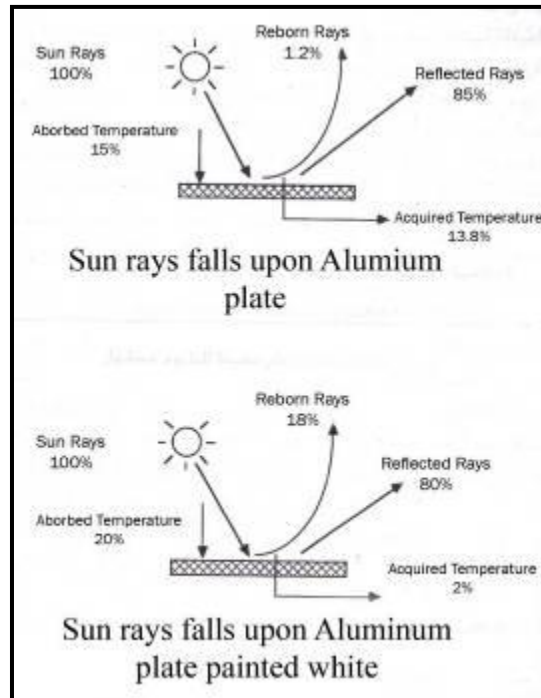


Figure 12. The two case show the white paint reflected 80 % of the sunrays – but the other case reflected 85%.. but the result is the gained heat in the white plate is 0.02 but the Aluminum plate is 0.138. (that mean the white color is the best one)

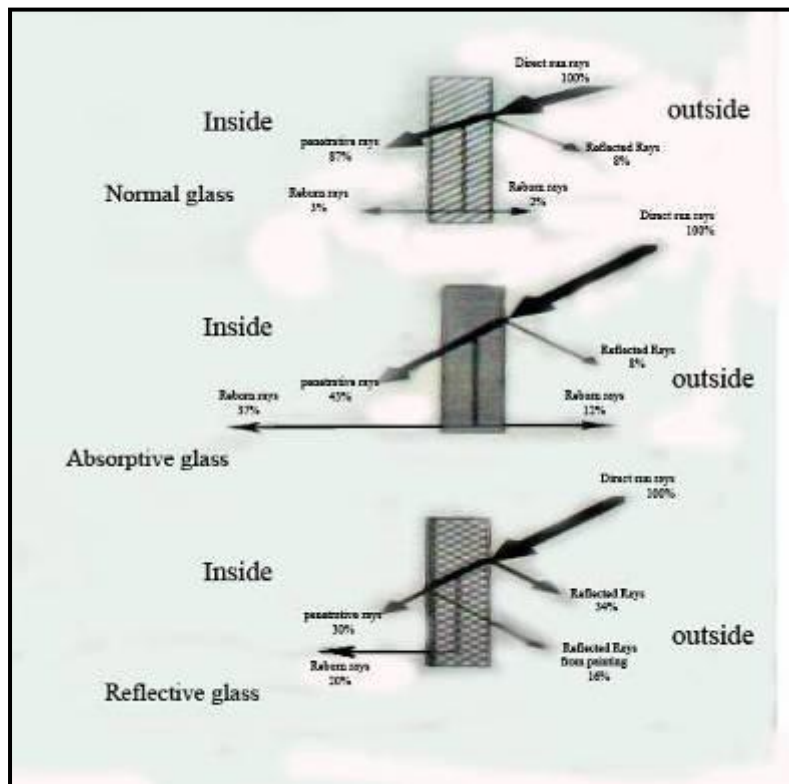


Figure 13. Penetrating rays upon glass areas

#### 4-3-2 \* ISOLATING THE HOT SUN- RAYS

##### ABOUT BUILDINGS:

From the last point we show that the isolating for heat by glass or wall materials, it help in giving reduction in the dispatched heat which help in realizing the thermal comfort in the houses fig (14)<sup>[5]</sup>, fig (15)<sup>[3]</sup>.

##### Natural Temperature For The Human Body

The isolation treatments of the hot sun – rays has to be done by two ways:

- Using sun breakers:

That means to prevent the hot sun rays to the windows glass or to the inner space of the houses or building. There are many types used in buildings: some are rigid and others are movable fig (6)<sup>[1]</sup>

- Trees which remains green and gives shadow:
  - trees from that type is very important in that hot zones around the pedestrians, parking areas, near buildings and in the green areas.
  - flowers plants: that gives the beauty and shadow then it is very suitable to take place in balconies as it is placed in the green areas.

The trees and plants specially in summer make a reduction in the temperature degree of the air from 70° to about 8°-25° in the zones lied in the shadow<sup>[6]</sup>.

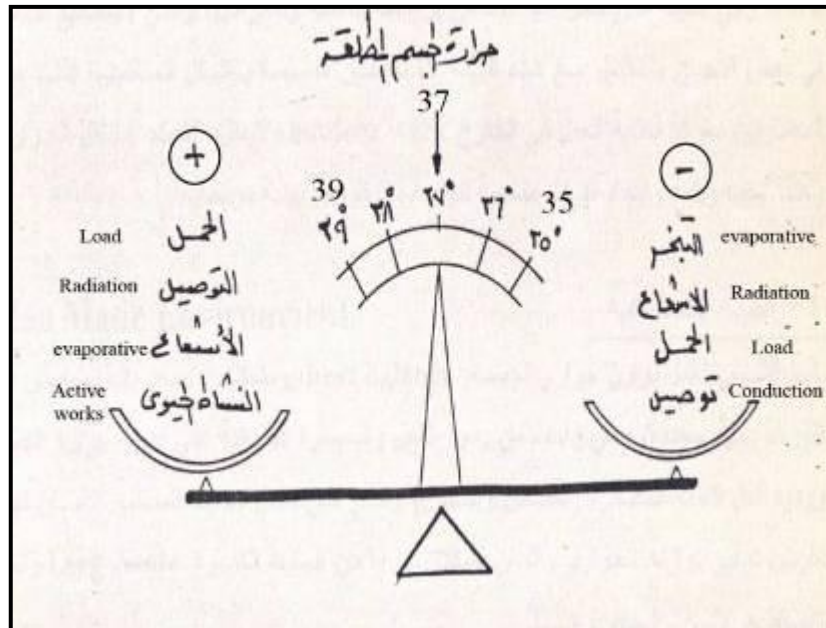


Figure 14. The Heating Balance For The Human Body

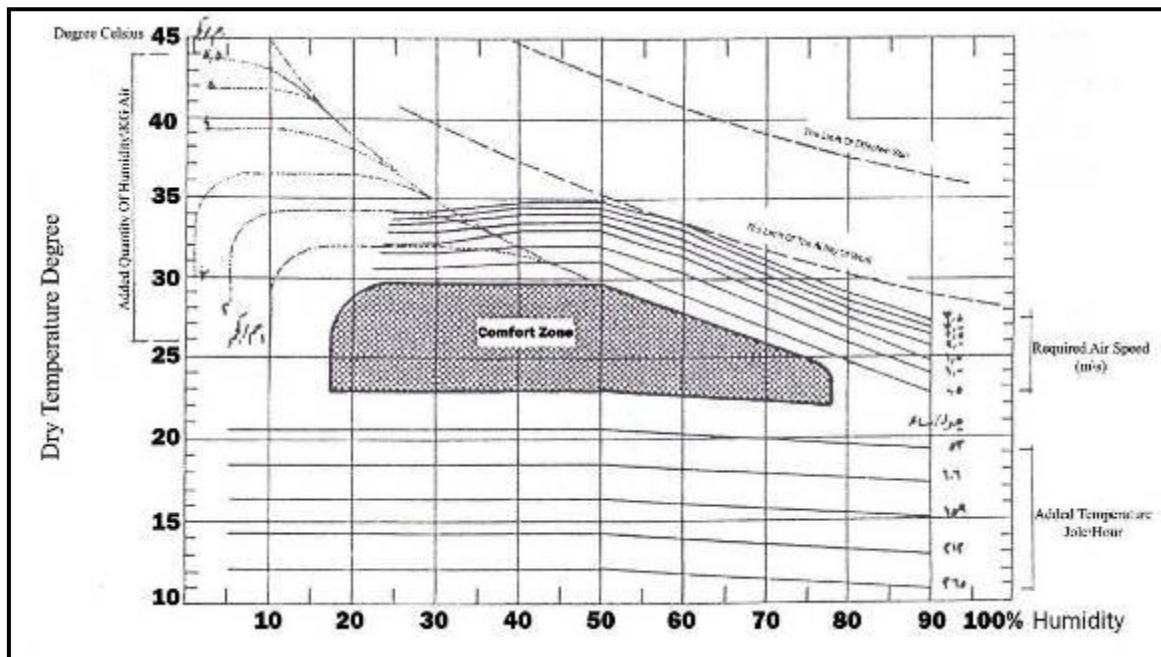


Figure 15. Thermal Comfort By Vector Olgay



#### **4-3-3 \* GREEN BUILDINGS AND PROTECTION FROM POLLUTION:**

It is one of the most important items for the green buildings to realize cleanse, pureness and the protection from pollution.

We could realize these items by two ways:

- Realizing the factor of cleaning in housing building by designing a room specially for the rubbish by using shaft in the behind in the inside facades and gathered by specially cars and to move it out of the city.
- Realizing the protection of pollution:  
That factor represented in trees, plants and the green areas which realized protection from it and it's injury upon environment and peoples which clear in these items:
  - Absorbing carbon oxide two: the green areas absorbed about 8 kilograms from (C O 2) in one hour.. that equals the quantity which out from 200 persons during breathing<sup>[6]</sup> and means the quantity of oxygen out of trees and green areas has an effective role in realizing the gaseous balance for air.
  - Absorbing dust: on hector from green areas absorbed about from 50-70 ton from dust at one year<sup>[6]</sup>
  - Reducing the level of noising: trees and green areas help in reducing the level of noising surrounding the housing zones coming from the main roads (80 \_ 90 disible) and the studies and measurements sure that the noising reaching trees is more the permissible limit (a bout 15 – 20 disible)<sup>[6]</sup>
  - Improving the environmental climate:  
Dense trees could cover about 95 % from all sun – rays down on land.<sup>[6]</sup>

#### **FIFTH TOPIC \* CIVILIZATION IN THE CONTEMPORARY ARAB CITY AND SUSTAINABILITY:**

The urban development is considered the point of changing in the Arab city..that meaning a system for arrangement and planning for constructing and improving the Arab city.. and that means sustainability ...

We must take care with executing many items:

- Preparing the general planning of the city: to put the future planning for resolving all problems of the city. and the future extensions, too the distributing of services and types of housing with a high network of streets as the new strategy system of the city.
- Distributing the housing types: that realized by studying the up – date case of housing and the visibility study for the future neediness up to the economical planning and the high technology of the 21 century.

- The arrangement and improving the street network and traffic: it is to be done under the rules of the urban planning..to give easy traffic and no danger for peoples and to encourage inhabitants to live in stability case.
- The justice distributing for services centers and the general green areas: that because of it is very important factors, and if it is no justice, the inhabitants moves daily from their houses to services shopping, to schools, to hospitals and to the general administration buildings.

This moving create a heavy burden to the traffic in the city if no arrangement and improving the streets net-works and traffic. and to realize the comfort in using transports and psychology comfort for inhabitants. the same thing for the general green areas specially in using it in holidays,feasts and occasions.

- Planning for industrial zones:  
There are many factors \ very important to avoid pollution by it's different shapes upon the city. From the heavy industry zones and the light industries which placed under planning and the national strategy of economic studies:
  - Choosing sites for heavy industrial zones out of cities near the regional streets and near the main streets of the city to make the moving of the working peoples so easy in traffic ways.
  - Choosing sites for heavy industries by taking care with the directions of winds: in the aim to avoid the pollution in air to be far away from the site of the city and the same time planting green belt of trees in between.
  - Light industries sites to be distributed in many sites with suitable areas in the urban zone in the city, like food industries, clothes industries and industrial services. it just must be useful for the urban environment, not to make confusion in the traffic moving or accidents and to have the solutions to protect housing zones from it's noise.
  - The effective local management:  
The city management must be effectives in urban societies, to execute the general planning of the city and the new extension settlements specially and to be under control in the housing zones to be in friendship with the environment that in according to the technical and environmental studies to have the green buildings, green zones and green city.
- Sun And wind Energy:  
The sun energy is a new and renew energy which all the world work to use it and to use it in heating water for houses.. and to producing electrical energy.. also the wind energy..all these attempts for producing clean energy from the sun rays and from the wind pressure, and to realizing rationalization in using the electrical energy.

## **\* RESULTS AND RECOMMENDATIONS:**

### **First: RESULTS:**

1. Green buildings are considered the buildings in accordance with the environment.
2. In it's design may be in consideration the system of protection from the hot sun – rays and realizing the elements of making shades and shadows and the natural lights and natural ventilation.
3. The human scale it must be realized in the green housing buildings and to be in connection with the surrounding environment
4. There are green areas in the space in between the group of housing buildings, that green areas full with trees and flowers plants which giving shadows, these are seats and some services.
5. Arab countries lies in the hot geographic zone with above 40 temperature, that mean the necessity to protect buildings from the hot sun –rays and to provide comfort hot by using the natural implements and new building and insulated materials.
6. There are many types of building materials has an effective role to reduce the hot degree of temperature inter the spaces of the building like reflecting hot sun –rays and other to prevent it and the third to late the time of hot rays from walls and others to provide with shade and shadow.
7. There are a relationship very effective and necessary between the green housing buildings and environment to have the possibilities to overcome the hot climate by:
  - devoting locations for green and flowered plants in the facades of the housing buildings.
  - limitation the locations of the shadow trees in the site specially around pedestrians ways, around the parking and near the housing buildings.
8. The flexibility in the interior design of houses as a system very effective in the green houses in the contemporary architecture designs, which realized building technic and consolidation, high performance in isolation the hot sun rays. and that considered the important elements of sustainability for the contemporary architecture.
9. The environmental planning for the housing green buildings, that is to be interact and in accordance with the concept of the green buildings..to be located and geography directed to obtain air and avoid hot sun – rays. to have a good composition and official spaces. realized safety, cleaning, to finish pollution.
10. Choosing the constructing materials suitable to the hot climate for the green housing buildings and for the pedestrian ways. by the suitable colors.
11. Sun and wind energy by using it in obtaining the electricity (the new energy) for houses uses, and at the same time we make a rationalization in using the electrical energy from it's usual resources.

**Second: RECOMMENDATIONS:**

1. The green house buildings is the future of the urban and environmental buildings for developing the Arab city. that mean the high importance to spread through all the Arab cities.
2. The governmental organizations must be take care to use that future and contemporary type of housing with new and fine designs for developing our cities and saving electrical energy.
3. The governments must put rules and legislations to planning the ARAB CITIES by urban planning and studies for progressing the urban built areas with the effective relationship with the surrounding environment.
4. Control and observing the developing in the cities to be in correct direction in planning housing zones, in using building materials and in arrangement urban spaces.
5. To making control upon the heavy industries and the location of it's zones, and to avoid any pollutions in air to the city and urban and rural settlements.
6. It must be making control for executing the green housing buildings to be in complete friendship with environment and it's elements are perfect without any pollutions.
7. The government and the specialist organizations must benefits with the sun and air energy for producing electricity from natural resources.

**REFERENCES:**

- (1) Saeed,1994.Bin Aouf\Saeed Environmental Elements And Architecture Design (book) King Saud University-Riadh KSA.
- (2) Center organization for numeration & mobilization 2003-Hadhramout Syeon Office yearly numeration book-Syeon-Hadhramout Government-Republic of Yemen.
- (3) Khaled, 2002 Fajal\Khaled-Architecture and Environment in the hot desert zones (book)- Cairo-Arab Republic Of Egypt.
- (4) Shafak, 1989 Alwakeel\Shafak, Alsarag\Muhammed-Climate and Architecture of the Hot Zones-Cairo Egypt.
- (5) Sabbah, 1995 Meshattet\Sabbah Architecture And Climatic Environment (Theoretical And Applying Fundamentals) – San'aa Yemen Republic.
- (6) Zohaire, 98-1999, Jabbor\Zohaire, Barakat\Hossam – Environmental Science – Faculty of Architectural Engineering – Baath University - Syria.